SECOND FIVE-YEAR REVIEW REPORT

MAYWOOD CHEMICAL CO. SUPERFUND SITE

BERGEN COUNTY, NEW JERSEY

Prepared by

U. S. Environmental Protection Agency
Region 2
New York, New York

SEPTEMBER 2014

Approved by:

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Emergency and Remedial Response Division

Sept. 30, 2014
Date

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Executive Summary

This is the second five-year review for the Maywood Chemical Co. Superfund Site located in Maywood, Lodi and Rochelle Park, Bergen County, New Jersey. The purpose of this five-year review is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory five-year review is the September 25, 2009, completion of the first five-year review.

Remedial action work is currently underway and addresses Site-wide radioactive soil and building contamination. This five-year review includes an evaluation of all response actions undertaken to date, which have been accomplished through excavation, transportation and off-site disposal of radioactively-contaminated materials to determine if they meet the 2003 Operable Unit 2 (OU2) Record of Decision (ROD) cleanup criteria which are used to make protectiveness determinations.

Based on this second five-year review, the remedy currently being implemented at OU2 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Maywood Chemical Co.		
EPA ID: NJD980529762		
Region: 2	**State:** NJ	**City/County:** Maywood, Lodi, Rochelle Park/Bergen County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the Site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: Other Federal Agency ***[If "Other Federal Agency", enter Agency name]*:** U.S. Army Corps of Engineers		
Author name (Federal or State Project Manager): Betsy Donovan		
Author affiliation: EPA Region 2 RPM		
Review period: 9/25/2009 - 9/25/2014		

Date of site inspection: 8/11/2014
Type of review: Statutory
Review number: 2
Triggering action date: 9/25/2009
Due date *(five years after triggering action date)*: 9/25/2014

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1, OU3, OU4

Issues and Recommendations Identified in the Five-Year Review:

OU(s): OU2	**Issue Category: Institutional Controls**			
	Issue: The selected remedy for OU2 soil and buildings has not been fully implemented. Additional remedial actions and institutional controls, which are part of the OU2 remedy, are needed.			
	Recommendation: Implement the Land Use Control Implementation Plan to fulfill the institutional control requirements for any property where radioactivity remains above the 2003 OU2 ROD unrestricted use cleanup criteria for soil and where inaccessible radioactive soil contamination remains in place.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	USACE	EPA/State	9/25/2017
OU(s): OU2	**Issue Category: Monitoring**			
	Issue: New EPA Radiation Exposure Guidance was issued in June 2014.			
	Recommendation: Evaluate new guidance and determine if it affects the OU2 remedy.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	**No**	**Federal Facility**	**EPA/State**	**9/25/2015**

Protectiveness Statement(s)	
Operable Unit:	*Protectiveness Determination:*
OU2	Will be Protective

Protectiveness Statement:

The remedy currently being implemented at OU2 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

Introduction

The purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment and is functioning as intended by the decision documents. The methods, findings and conclusions of reviews are documented in the five-year review. In addition, five-year review reports identify issues found during the review, if any, and document recommendations to address them.

This is the second five-year review for the Maywood Chemical Co. Site, located in Maywood, Lodi and Rochelle Park, Bergen County, New Jersey. This five-year review was conducted by the United States Environmental Protection Agency (EPA) Remedial Project Manager (RPM) Betsy Donovan. The review was conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, 42 U.S.C. §9601 *et seq.* and 40 CFR 300.430(f)(4)(ii), and in accordance with the *Comprehensive Five-Year Review Guidance*, OSWER Directive 9355.7-03B-P (June 2001). This report will become part of the Site file.

The triggering action for this statutory review is the completion date of the previous five-year review which was issued on September 25, 2009. A five-year review is required at this Site due to the fact that hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. The Site consists of four operable units. OU2 for radioactively-contaminated soil and buildings is addressed in this five-year review. Implementation of the remedial action for the other three OUs has not yet begun and therefore those OUs are not addressed by this five-year review. Status of the other three OUs is summarized as follows. The OU1 ROD for chemical contamination in soil on the Stepan Company property and adjacent properties formerly owned by Maywood Chemical Works (MCW) was issued on September 23, 2014. The OU3 remedy for groundwater contamination associated with the government-owned Maywood Interim Storage Site (MISS) and radioactive groundwater contamination throughout the Site is in remedial design. The OU4 remedy for chemical groundwater contamination associated with the former MCW operations that were not located on the MISS is under investigation.

Site Chronology

The Maywood Site has been the subject of numerous environmental investigations and remediation work dating back to early 1960s, as a result of inspections performed by the Atomic Energy Commission (AEC), the predecessor agency to Nuclear Regulatory Commission (NRC). In addition, New Jersey Department of Environmental Protection (NJDEP), U.S. Department of Energy (DOE), EPA and U.S. Army Corps of Engineers (USACE) conducted Site investigations. Remediation activities were implemented by Stepan Company (Stepan), DOE and USACE.

A brief description of historical investigations and cleanup activities is presented in Table 1: Chronology of Site Events.

Background

Physical Characteristics

Site Location and Description

The Maywood Site consists of more than 88 industrial, residential, commercial and government properties contaminated by former thorium and chemical processing activities by the former MCW. The properties are located in a highly developed area of northeastern New Jersey in the Boroughs of Maywood and Lodi and the Township of Rochelle Park. The Site is located approximately 12 miles north-northwest of New York City and 13 miles northeast of Newark, New Jersey (Figure 3-1). A Site map is shown on Figure 1-1. The Remedial Investigation (RI) for OU2 divided the Site into four property units based on land use:

- Maywood Interim Storage Site;
- Stepan Company;
- Residential vicinity properties; and
- Commercial and government vicinity properties

Maywood Interim Storage Site (MISS)

The MISS is an 11.7-acre fenced lot that was previously part of a 30-acre property owned by Stepan (Figure 1-1). The federal government acquired the MISS from Stepan in 1985. The MISS contains two buildings (Building 76 and a Pump House), temporary office trailers, a water reservoir and two railroad spurs. The water reservoir and Pump House are still in use by Stepan. It is bounded on the west by New Jersey State Route 17; on the north by a New York, Susquehanna, and Western Railway line; and on the south and east by the Stepan property. Residential vicinity properties are located north of the railroad line and within 300 yards to the north of the MISS. A chain-link fence encloses the property. Access is restricted within the fenced area.

Stepan Company

Stepan Company, a pharmaceutical and chemical manufacturer that purchased the former Maywood Chemical Works property in 1959, is located at 100 West Hunter Avenue in the Borough of Maywood (Figure 1-1). The property covers 18.2 acres. The topography of the property has been modified into a series of terraces to accommodate construction of the operating facility. Topographic relief from the highest terrace at the north side to the lowest terrace at the south side of the property is about 25 feet. Approximately two-thirds of the property contains buildings. Former thorium processing buildings were located on the present-day MISS. The Stepan property contained three NRC-licensed burial pits. A chain-link fence encloses the property

(excluding the main office and parking area) and access is restricted within the fenced area. West Hunter Avenue is lined with small businesses, as is a portion of nearby Maywood Avenue. The area east of Maywood Avenue from the Stepan property is predominantly residential. To the north and northeast, a New York, Susquehanna, and Western Railway line and numerous residential vicinity properties border the property. Various commercial properties border the Stepan property to the south and southwest. The MISS adjoins the Stepan property on the west and northwest.

The OU2 ROD identified two buildings on the Stepan property (Buildings 1 and 78) and one on the MISS (Building 76) which will require remediation, and several which require additional characterization. In all contaminated buildings, the radioactivity is fixed in place and is not transferable. The primary route of exposure for fixed contamination is direct exposure to gamma radiation. Environmental monitoring is performed regularly to ensure that workers and the surrounding community are protected. USACE submitted a draft building survey plan in 2014 and plans to survey the buildings in the fall of 2014 to determine the extent of remedial action necessary.

Residential Vicinity Properties

DOE designated 59 residential properties, as vicinity properties (Figure 1-1). DOE used the term vicinity property to distinguish those properties from the Stepan Company and federal government-owned MISS properties. DOE identified these properties through surveys performed by Oak Ridge National Laboratory (ORNL) in 1984. The residential vicinity properties were contaminated by transport of soil by surface water runoff along former stream channels or by use of contaminated material as fill and mulch.

Commercial and Government Vicinity Properties

Commercial/government vicinity properties are comprised of 27 properties, located in the Boroughs of Maywood and Lodi, and the Township of Rochelle Park (Figure 1-1). Of these 27 properties, 20 are commercial properties, four are municipal properties (three parks and a fire station), and the remaining three are state- and federally-owned properties (right-of-way and an embankment for Interstate 80, a State Route 17 embankment and a New Jersey Vehicle Inspection Station).

Two of the commercial properties (96 Parkway and 149-151 Maywood Avenue) and one government property (State Route 17) were originally part of MCW and were used for waste storage and burial. The remaining commercial and all government properties were believed to have been contaminated by transport of soil by surface water runoff along former stream channels or by use of contaminated material as fill and mulch. The majority of the contaminated material is soil; however, there were isolated areas where stream or wetlands sediments were contaminated.

Geology/Soils

The bedrock underlying the Site is divided into two distinct units - bedrock composed of the Triassic- to Jurassic-age Passaic Formation, and overburden of unconsolidated

glacial till. The Passaic Formation, which reaches a maximum thickness in excess of 8,000 feet, is part of a 33,800 feet sequence of sediments deposited in the Newark Basin during the Triassic and Jurassic time periods. The Passaic Formation consists of interlayered dark to moderate red-brown, fine-grained sandstones and siltstones. Beds exhibit a monoclinal dip of 10 to 15 degrees northwest and contain shallow open folds.

The northeast-trending Ramapo Fault that marks the westerly margin of the Newark Basin bound minor north-trending faults in the Triassic formations to the northwest. The Ramapo Fault at its nearest location is about 13 miles west-northwest of the Site. Minor faults, fractures, and joints are prevalent throughout the Newark Group. A prominent set of joints parallels the strike of beds and dips steeply; another less prominent set parallels the northwest direction of dip. Bedrock topographic lows at the Site show alignment to northwest and northeasterly trends that are probably the result of bedrock weakness caused by joining in the Triassic Formations. At the Site, beds of the Passaic Formation also exhibit extensive weathering, and horizontal jointing in this formation is probably related to weathering.

Unconsolidated material overlying the weathered bedrock consists of sands, silts, and clays deposited as a result of glaciating during the Pleistocene time period. The thickness of unconsolidated sediments varies over the Site. Bedrock is within six inches of the surface near the northern end of the Stepan property where there is a pronounced bedrock high. The overburden reaches a maximum thickness of over 25 feet in a downcut channel on the MISS property.

Unconsolidated deposits are loosely divided into three groups at the Site - a lower unit of fine grained sands and silts with occasional coarse gravels and sands, a middle unit of clays and silts with occasional organic-rich soil horizons, and an upper unit of undifferentiated sands and silts, which is much disturbed by urban development. Erosional lows that downcut into bedrock contain sands and gravels are probably of fluvial origin. This sequence of deposits is interpreted as being deposited from streams and lakes that originated from glaciers to the north. Periodically, during the advance and retreat of glaciers, the environments of deposition would change, which has resulted in the glacial sediments exhibiting a high degree of lithologic variability, both vertically and horizontally. In some cases, streams originating from glaciers cut valleys into existing sediments. The location and orientation of these valleys were probably controlled by weaknesses in the bedrock geology.

Historically, the glacial deposits of the Maywood area were capped with a well-developed deciduous forest soil. Extensive agricultural and urban development has destroyed or disturbed much of the original soil and most of the current soil cover is classified as urban fill.

Topography, Drainage and Surface Water

The Site is located in the glaciated section of the Piedmont Plateau of north-central New Jersey. The terrain is generally level, with highs and lows created by occasional

low mounds and shallow ditches. Elevation ranges from 51 to 67 feet above mean sea level. The surface slopes gently to the west and is poorly drained.

The Site lies primarily within the Saddle River drainage basin. The MISS is located about 0.5 mile east of the Saddle River, which is a tributary of the Passaic River, and about one mile west of the drainage divide of the Hackensack River basin. Rainwater runoff from most of the MISS empties into the Saddle River through Westerly Brook, which flows under the property and under State Route 17 through a concrete culvert. It eventually empties into the Saddle River. Neither the Saddle River nor Westerly Brook is used as a source of potable water.

Another perennial stream on the Site, Lodi Brook, originates as two branches on the 149-151 Maywood Avenue property. Because of construction, most of the original stream channel has been replaced by a storm drain system beneath the surface. The original stream channel has been determined from old photographs and maps. The former channel pathways basically match the distribution of contaminated materials in the Borough of Lodi. Contaminated materials were transported from the MISS via sediment deposition. A structure and parking lot at 149-151 Maywood Avenue currently cover the western branch of Lodi Brook. The easternmost branch drains the surface area outside the fence on this property and then flows underground for most of its route to the Saddle River. Some surface runoff from the MISS moves parallel to State Route 17 and drains into Lodi Brook. Lodi Brook empties into the Saddle River, downstream of the Westerly Brook confluence with the Saddle River. The 111 Essex Street property lies adjacent to Coles Brook. Coles Brook flows north-northeast and is part of the Hackensack River basin.

Land and Resource Use

The Site is located in three communities - the Borough of Maywood, the Borough of Lodi and the Township of Rochelle Park. Land use planning is guided principally by Municipal Land Use Law (Chapter 291, Laws of New Jersey, 1976) which requires municipalities to re-examine and update their Master Plans and development regulations every six years.

Borough of Maywood Land Use

Land use at the MISS, Stepan Company and the 14 commercial and government vicinity properties located in the Borough of Maywood is currently zoned for limited light industrial activities. Most of the Borough of Maywood, including the 10 residential vicinity properties, is zoned for residential use. Industrial land uses comprise about nine percent of the total land area of the Borough of Maywood. This classification permits light manufacturing operations as well as the related functions of processing, wholesaling, warehousing and storage of goods. Regarding future land use, the Maywood Master Plan recommends maintaining the light industrial zoning classification for all properties except for the MISS, where a commercial, high-rise zoning designation has been recommended.

Borough of Lodi Land Use

Land use on the eight commercial and government vicinity properties located in the Borough of Lodi is currently zoned for commercial and industrial use. Most of the Borough of Lodi, including 44 residential vicinity properties, is zoned for residential use. Commercial and industrial land uses comprise about 15percent and 13percent, respectively, of the total area of the Borough of Lodi. These commercial/government properties are contained within defined commercial and industrial land use areas. However, many properties are located immediately adjacent to residential or recreational use areas. The commercial use classification in Lodi permits smaller commercial buildings, convenience stations, planned shopping centers, auto-related establishments, retail stores and restaurants. Regarding future land use, the Master Plan recommends maintaining the current land uses for all properties.

Township of Rochelle Park Land Use

Land use for the portion of the MISS, Stepan Company and the 149-151 Maywood Avenue property that are located in the Township of Rochelle Park is currently zoned for industrial use. One other commercial property, 96 Parkway, is also currently zoned for industrial use. Most of the Township of Rochelle Park, including the nine residential vicinity properties, is zoned for residential use. The commercial and industrial land uses comprise about 17 percent of the total land area of the Township of Rochelle Park. Regarding future land use, the Master Plan recommends maintaining the current land uses for all site properties.

Surface Water and Groundwater Uses

Surface water at the Site is not currently impacted by Site radiological contaminants, nor is a future impact expected. Surface water is not used as a source of potable water. Current surface water use is not projected to change significantly in the future.

Groundwater at the Site occurs in both the bedrock Passaic Formation and the unconsolidated glacial deposits. The Passaic Formation, classified as Class II, is a productive aquifer that is a major source of water for public and industrial use. Although groundwater is generally not used for municipal water supply in the lower Saddle River Basin, and the bedrock aquifer in the vicinity of the Site is not currently used for drinking water or other domestic use, it is classified as a potential source of drinking water.

Groundwater is outside the scope of this five-year review, since the remedies for groundwater have not yet been implemented. Future five-year reviews will evaluate groundwater conditions at the Site.

History of Contamination

The original plant, which became known as the MCW in 1918, was constructed in 1895. The principal products manufactured by MCW included chemicals used in the pharmaceutical, food, glass, soap and metals industries. Starting in 1916, the plant was used to extract thorium and rare earth metals from monazite sands for use in

manufacturing industrial products, such as mantles for gas lanterns. Thorium and rare earth metals were extracted from the monazite sands using an acidic separation process. The wastes from this process were pumped as slurry to holding ponds. Wastes from these ponds were later transferred into Burial Pits 1 and 2. The liquid portions of the ponds containing the thorium and rare earth metals were separated from the tailings, and thorium was separated from the rare earth metals. Some concentrated thorium residues were pumped into a holding pond where the thorium portion of the residues was precipitated as a phosphate. Wastes from this holding pond were later transferred into Burial Pit 3.

Process wastes from the thorium extraction operations were pumped into two areas surrounded by earthen dikes on property west of the plant. In 1932, the disposal areas were partially covered by the construction of State Route 17. Waste retention ponds existed on portions of MCW that now comprise 96 Parkway (also referred to as the Ballod property), the MISS, and 149-151 Maywood Avenue. MCW also produced detergents, alkaloids, essential oils, and lithiated compounds, including lithium chloride and lithium hydroxide. Lithium wastes were believed to have been disposed in diked areas on the MCW property. Protein extraction from leather digestion was also carried out by MCW. Leather wastes were buried in two primary shallow disposal areas on Stepan, just east of the MISS property boundary.

According to a 1942 memorandum, the products manufactured by MCW can be broken down into six major groups - aromatics, flavorings, lithium metal and salts, pharmaceuticals, rare earth salts and miscellaneous products.

- The principal products of the aromatic group are ionone and iraldiene (methylated ionone) and were used mainly in the soap industry. The raw material, for the most part, consisted of lemongrass oil imported from India.

- The principal products of the flavorings group were coumarin (manufactured by MCW as a coal tar derivative), and vanillin, which is a synthetic vanilla made from cloves imported by MCW from Zanzibar. Vanillin was also synthesized from orthoanisidene and para-phenetidene.

- Lithium was manufactured by MCW in at least 30 forms. Spodumene ore was brought from mines owned and operated by the company in South Dakota; lithium was then extracted from the ore at MCW. Lithium was used for the purification of other metals, for the manufacture of storage batteries and for military purposes.

- The principal pharmaceuticals manufactured by MCW were quinine, cocaine, theobromine, acetanilid and caffeine.

- Rare earth salts were derived from monazite sands that MCW imported, primarily from India. The most important rare earths manufactured by MCW were cerium, lanthanum and neodymium. These products were used, for the most part, by the glass industry. Thorium was also derived from the monazite sands, and sold for use

in the manufacturing of thorium mantles for lanterns. Cerium was also used as an important ingredient in gas mantle coatings.

Process wastes from these manufacturing processes were generally stored in open piles and retention ponds on the MCW property. Some of the process wastes were removed for use as mulch and fill on nearby properties, thereby contaminating those properties with radioactive thorium. Although the fill consisted primarily of tea and coca leaves from other MCW processes, these materials were apparently contaminated with the thorium-processing wastes. Additional waste migrated off the property via natural drainage associated with the former Lodi Brook. MCW ceased thorium extraction in 1956, after approximately 40 years of production. The property was subsequently sold to Stepan in 1959.

Initial Response

In 1961, Stepan was issued an AEC radioactive materials storage license. This was based on AEC inspections and information related to the property on the west side of State Route 17 (known currently as the 96 Parkway property). Stepan subsequently began cleaning up the residual thorium wastes. From 1966 through 1968, Stepan removed residues and tailings from an area east of State Route 17 and the 96 Parkway property, and reburied them on the Stepan property in Burial Pits 1, 2, and 3. In 1968, AEC conducted a survey of the area west of State Route 17 and certified it for use without radioactive restrictions. At the time of the survey, AEC apparently was not aware of waste materials still present on the property. The Stepan property west of State Route 17 was sold in the same year to a private citizen who later sold it to Ballod Associates in the 1970s.

The presence of radioactive materials in the northeast corner of the 96 Parkway property was discovered in 1980, after a private citizen reported the presence of radioactivity near State Route 17 to the NJDEP. A survey of the area (State Route 17, 96 Parkway property, and Stepan property) conducted by NJDEP found thorium-232 (Th-232) and radium-226 (Ra-226). NRC was notified of the results and additional surveys were completed from November 1980 to January 1981. These surveys confirmed high concentrations of Th-232 in soil samples collected from both the Stepan and 96 Parkway properties. Accordingly, NRC requested a comprehensive survey of the area. NRC was notified because of its involvement with Stepan's licensed thorium activities and AEC's previous release of the area west of State Route 17 for use without radiological restrictions.

In January 1981, NRC arranged for an aerial radiological survey of the Stepan property and surrounding properties. The survey, which covered a 3.9-square mile area, indicated the presence of radioactivity not only on the Stepan and 96 Parkway properties, but also in areas to the north and south of the 96 Parkway property. During February 1981, NRC also performed a separate radiological ground survey of the 96 Parkway property, the results of which eventually led to its designation for remedial action under the Formerly Utilized Sites Remedial Action Program (FUSRAP). An

additional radiological survey of the Stepan and 96 Parkway properties, commissioned by Stepan, produced similar findings. EPA added the Site to the National Priorities List (NPL) on September 8, 1983, due to thorium waste which resulted in radiation levels, including radon, above natural background levels.

By enacting a provision of the fiscal year 1984 Energy and Water Development Appropriations Act, Congress authorized DOE to undertake a decontamination research and development project at the Site in late 1983. Accordingly, a portion of the Site was assigned to FUSRAP, and DOE obtained access to an 11.7-acre portion of the Stepan property for use as an interim storage facility for materials that were to be removed from vicinity properties. This area is now known as the MISS. In late 1983, DOE began surveys of properties in the vicinity of the former MCW plant.

In 1984 and 1985, DOE conducted removal actions at 26 properties, based on the results of the 1981 radiological surveys. Excavation cut lines were based on soil sample results, and walkover gamma and downhole gamma logging surveys. The surface and subsurface readings of 11,000 and 40,000 counts per minute (cpm) were used as a correlation to 5 picoCuries per gram (pCi/g) and 15 pCi/g, respectively, for Th-232. Excavated soils were then transported to the MISS for temporary storage. At that time, commercial disposal facilities were not available for the volume of radioactive waste generated by the cleanup. Post-remedial action sampling included: surface gamma radiation scans; soil sampling for Ra-226, Th-232 and Uranium-238 (U-238); and exposure rate measurements. Details of the post-remedial action sampling are described in the first five-year review report. In September 1985, ownership of the MISS was transferred to the federal government.

A September 17, 1990, Federal Facility Agreement (FFA) between EPA and DOE established terms and requirements of the CERLCA cleanup. In 1993, EPA and DOE disagreed on the soil cleanup criteria that should be applied to the radioactive materials remaining at the Site. Therefore, EPA and DOE entered into a dispute resolution process. This disagreement was resolved in 1994 in a document known as the "Dispute Resolution" with site-specific cleanup criteria established at an average of 5 pCi/g combined Ra-226 and Ra-228, above background, for residential properties. For commercial properties, the dispute established cleanup criteria of an average of 15 pCi/g combined Ra-226 and Ra-228, above background, with an "as low as reasonably achievable" (ALARA) goal of 5 pCi/g. USACE determined that attainment of these cleanup criteria would assure compliance with the relevant and substantive requirements of the State of New Jersey radiation dose standards for the remediation of radioactive contaminated properties.

By September 1994, commercial disposal facilities became available and DOE released an Engineering Evaluation/Cost Analysis (EE/CA) evaluating several potential removal alternatives. DOE then selected a non-time critical removal action in an Action Memorandum for the removal of the interim waste storage pile to such a facility. This removal was initiated in 1994 and completed in 1996. In September 1995, DOE released a separate EE/CA evaluating removal alternatives for the

remaining residential, one commercial, and four municipal properties. This action was initiated in 1995 and was completed in 2000.

The Dispute Resolution soil cleanup criteria were used for the properties remediated from 1995 to 1999. Contaminated materials from 38 properties remediated during 1995-1999 were excavated, transported to the MISS, loaded into railcars and shipped to an off-site commercial disposal facility in Utah. At properties where contamination was present below structural items such as houses and garages, underpins for wall footings of the structure were installed to support the structure and to facilitate removal of contaminated materials thereof. Post-remedial action sampling completed at the remediated properties consisted of surface gamma radiation scans, soil sampling and exposure rate measurements. The post-remedial action data were provided to an independent verification contractor (IVC) for review to determine whether remediated areas were in compliance with the cleanup criteria. Details of the post-remedial action sampling are described in the first five-year review report.

Basis for Taking Action

Numerous investigations have taken place at the Site prior to and after the NPL listing, as described above and in Table 1. In 1992 DOE issued a *Remedial Investigation Report for the Maywood Site*, which was the basis for DOE's 1993 *Final Baseline Risk Assessment for the Maywood Site.* This baseline risk assessment identified radiological contaminants of concern (COCs) and their associated decay products in soils at the site which posed an unacceptable risk from direct contact to employee and transient populations. COCs for soil and building materials were identified in the risk assessment as follows: Th-232; U-238; and Ra-226) Radon-222 (Rn-222) was also identified as a COC for indoor air. An ecological risk assessment was conducted to evaluate potential effects from contamination at the Site. The ecological assessment compared contaminant concentrations detected in various media (soil, sediment and water) at the site with literature on contaminant toxicity to biota. Because the future use of the Site was concluded to likely remain industrial and remedial action will likely remove contaminated soils to depths affecting ecological resources, the ecological assessment concluded that cleanup criteria for the remedy should not be based on potential risks to ecological resources.

Remedial Actions

Remedy Selection and Cleanup Criteria

The Maywood Site consists of 88 industrial, residential, commercial and government properties contaminated by former thorium and chemical processing activities. The general remedial approach for cleanup work undertaken to date has been to excavate and dispose of the contaminated soils off-site and to remove and dispose of the contaminated building materials. Prior to the selection of the OU2 remedy, 64 of the 88 properties were remediated by DOE and USACE via removal actions (as described above) and are referred to as Phase I properties.

Twenty-four commercial and government properties are addressed under the 2003 OU2 ROD. Based on the historical commercial/industrial use of the Site, the proximity of heavily used transportation corridors (e. g., State Route 17, Interstate-80), and the well-defined commercial/industrial districts, the use of the restricted use cleanup criteria were justified for and applied to select commercial and government vicinity properties. For the remaining properties, cleanup to the unrestricted use criteria is considered more appropriate since they are located within a less defined commercial district with encroaching residential developments on three sides. The general remedial action objectives (RAOs) for the Site, as defined in the 2003 OU2 ROD, are to prevent or mitigate the further release of FUSRAP waste to the surrounding environment, and to meet the established cleanup criteria and comply with applicable or relevant and appropriate requirements (ARARs). Note that the USACE initiated work for some of these properties in accordance with a 2001 EE/CA for a "Removal Action in Support of NJDOT Roadway Improvement Projects" at the Site.

Media-specific OU2 RAOs:
Source Media (soil and bulk waste)

- To eliminate or minimize the potential for humans to ingest, come into dermal contact with, or inhale particulates of radioactive constituents, or to be exposed to external gamma radiation.
- To reduce radium and thorium concentrations in soil including the NRC licensed burial pits to levels in accordance with EPA / DOE dispute resolution cleanup criteria. An average of 15 pCi/g combined Ra-226 and Th-232 above background for the subsurface soils with an ALARA goal of 5 pCi/g; institutional controls to prohibit future residential use will be used. For unrestricted use, the cleanup criterion is an average of 5 pCi/g combined Ra-226 and Th-232 above background for soil.
- To reduce Site concentrations of U-238 to 50 pCi/g (which is essentially 100 pCi/g total uranium) above background. These levels are considered protective for unrestricted use.
- To comply with exposure dose limits of 15 millirem per year (mrem/yr) as specified in NJAC 7:28-12.8(a)1.*
- To reduce the potential for environmental impacts and reverse the temporary disturbance of existing wetland habitats through removal of sediments exceeding the cleanup criteria.
- To eliminate or minimize toxicity, mobility, and/or volume of contaminated soils.
- To eliminate or minimize the potential migration of COCs into stream and storm drain sediments by surface water runoff.

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* The exposure dose limit of 15 mrem/yr above background, as specified in NJAC 7:28-12(a)1, applies to the sum of annual radiation, which includes the combined dose from both sources media (soil and bulk waste) and the building / structures.

- To eliminate or minimize the potential migration of COCs by infiltration or percolation that would result in contamination of the groundwater.
- To comply with ARARs.

Buildings / Structures

- To comply with exposure dose limits of 15 mrem/yr as specified in NJAC 7:28-12(a)1.
- To prevent radon concentrations in buildings from exceeding 3 picoCuries per liter (pCi/L) above background as specified in NJAC 7:28-12.8(a)2 .
- To eliminate or minimize toxicity or mobility, and/or volume of COCs.
- To comply with ARARs.

The 2003 OU2 ROD addresses the radiologically and chemically contaminated wastes in soils and buildings, as defined as FUSRAP waste. Under the terms of the FFA, FUSRAP waste consists of:

- All contamination, both radiological and chemical, whether mixed or not, on the Maywood Interim Storage Site. The MISS is the 11.7-acre property acquired by DOE to store excavated materials due to the limited commercial disposal capacity for radiological wastes.

- All radiological contamination above cleanup levels related to past thorium processing from the MCW occurring on any of the vicinity properties.

- Any chemical or non-radiological contamination on vicinity properties that would satisfy either of the following requirements:

  - The chemical or non-radiological contaminants that are mixed or commingled with radiological contamination above cleanup levels.

  - The chemical or non-radiological contaminants that originated at the MISS or were associated with the specific thorium manufacturing or processing activities at MCW that resulted in the radiological contamination.

The cleanup criteria established in the 2003 OU2 ROD for the radioactive soil and building contamination at the Site are summarized in Table 2.

A notable change in the cleanup criteria from previously remediated properties (1995-1999) was:

- 15 millirem per year (mrem/yr) above background dose limit specified in the New Jersey Administrative Code (NJAC) 7:28-12.8(a)1 for all properties addressed in the 2003 OU2 ROD.

The 15 mrem/yr requirement as specified by NJAC 7:28-12.8(a)1 is considered an ARAR for the remediation of the NRC-licensed burial pits on Stepan property (see

Figure 3-3), which also needs to meet NRC regulations at 10 Code of Federal Regulations (CFR) 20.1402 (25 mrem/yr).

In addition, the 2003 OU2 ROD cleanup criteria also specify the following:

- Any Site remediation-derived water discharged to a Publicly Owned Treatment Works (POTW) is required to meet or exceed the POTW's designated pretreatment standards prior to discharge.

- Any Site remediation-derived water discharged from a point source to a surface water body or groundwater is required to comply with the relevant and appropriate promulgated State and Federal standards for the site-specific contaminants of concern (COCs). In the absence of specific discharge limitations, point source discharges are required to meet or exceed federal maximum contaminant levels for each COC.

Natural background levels of the radionuclides used in evaluating soil samples were established by analyzing soil in nearby areas that were not affected by the Maywood Chemical Works activities. The details of these analyses are described in the first five-year review report.

The major components of the selected remedy under the 2003 OU2 ROD consist of:

- Excavation of accessible soils to meet ARARs and soil cleanup criteria for either restricted or unrestricted use as discussed above for each property using federally accepted averaging methods (e.g., Multi-Agency Radiation Survey and Site Investigation Manual [MARSSIM]) to demonstrate compliance with the criteria.

- Physical separation, using backhoes or other heavy construction equipment, of a portion of the excavated material to sort boulders and rocks, waste potentially requiring disposal as mixed waste (radioactive and hazardous waste), and bulk waste such as building rubble.

- Remediation of contaminated buildings/structures (or demolition and disposal as deemed appropriate at the time of work) in consultation with the property owners, as necessary to achieve the criteria of 15 mrem/yr above background as specified in NJAC 7:28-12.8(a) 1 and the 3 pCi/L Rn-222 limit in NJAC 7:28-12.8(a) 2.

- Excavation of inaccessible soils to meet ARARs and cleanup criteria for either restricted or unrestricted use as discussed above if the landowners make them accessible during remediation; otherwise, inaccessible soils currently located under buildings and roadways would be excavated and disposed off-site as they become accessible in the future (e.g., due to renovation or demolition activities).

- Demolition and disposal of structures on the MISS to access contaminated soils.

- Off-site disposal of all materials above the cleanup criteria at facilities authorized to accept radioactive waste in accordance with applicable regulations.

- Five-year reviews in accordance with CERCLA 121 (c) and 300.430(f)(4)(ii).

- Requesting notification of the USACE and EPA by local municipalities of any land use changes involving those properties where radioactivity remains above an average of 5 pCi/g of Ra-226 and Th-232 combined above background concentrations in soils.

- Periodic Rn-222 monitoring of structures over inaccessible soils to ensure that the structures continue to provide adequate protection from these soils; mitigation of Rn-222 (e.g., sealing foundation cracks, supplementing existing ventilation systems, etc.) would be performed if indoor air levels exceed 3 pCi/L above background.

- Working with local authorities and landowners to implement land use controls (e.g., deed notices, easements, covenants, zoning controls, etc.) on a property by property basis, as necessary, for those properties where radioactivity remains above an average 5 pCi/g of Ra-226 and Th-232 combined above background concentrations in soils and/or due to the presence of inaccessible soil. Objectives of the institutional controls would be to restrict land use to commercial/industrial, prohibit residential or unrestricted use, and prohibit excavation into designated restricted areas. Institutional controls would remain in place as long as Site contaminants remain above levels that allow for unrestricted use.

Remedy Selected for OU3 Groundwater

EPA and USACE issued a ROD for OU3 FUSRAP groundwater in July 2012. The OU3 remedy calls for removal of source areas in soil that impact groundwater, *in situ* treatment of arsenic in overburden aquifer if needed, and monitored natural attenuation of overburden and bedrock contamination. The OU3 remedy is currently being designed and will be evaluated once implemented.

Remediation Completed for Properties in the 2003 OU2 Record of Decision

Remedial actions have been undertaken or are underway at 24 designated properties included in the 2003 OU2 ROD. USACE estimates that the remaining OU2 remedial action work will take another 10 years to complete and is dependent on Congressional appropriation funding.

Radiological data collected during investigations were used to plan remediation activities. Excavation was performed based on the excavation limit depicted on the design drawings showing the extent of contamination at each of these properties. Excavated materials were transported to the MISS for temporary storage, and

subsequently transported off-site to a facility authorized to accept radioactive waste in accordance with applicable regulations.

Post-remedial action sampling at the remediated properties was conducted utilizing a MARSSIM-based approach. The sampling consisted of gamma walkover surveys and soil sampling. Based on the available Post Remedial Action Reports (PRARs), all the remediated properties were deemed to have met the respective cleanup criteria for restricted use or unrestricted use, as specified in the 2003 ROD with the exception of five properties where inaccessible contamination was present. At these five properties, due to safety concerns and structural stability issues, contaminated soils could not be removed from areas underneath and immediately adjacent to, permanent structures such as buildings, a pump station, a sewer force main, a natural gas pipeline and/or utility poles. As such, rather than the unrestricted use originally specified in the 2003 OU2 ROD, these five properties have restricted use designations, with proposed implementation of institutional controls (i.e., administrative, legal, and/or physical measures that control potential or actual human health risks),as required by the OU2 remedy. Contaminated soil which is considered inaccessible will be addressed in the future when it is made accessible by property owners by removal of the permanent structure. Following verification that cleanup criteria had been met, excavated areas were backfilled with clean fill. Radiological results for the backfill were compared to applicable guidelines. Chemical results were compared to applicable New Jersey soil cleanup criteria/background concentrations. Backfill and clean overburden soil results were below applicable regulatory criteria. Upon completion of the remedial actions, the property was restored to its original condition.

System Operation/Operation and Maintenance

The remedial activities completed for Phase I properties allowed an unrestricted use designation; therefore, operation and maintenance activities were not required at these properties. For OU2 properties, inaccessible soils underneath permanent structures are known to be present at four properties which were designated for restricted use. Post-remediation radon testing was performed at these four properties and interior gamma survey and inspection for any cracks in basement slabs have also been conducted. Periodic radon monitoring at these properties is included in the USACE's Land Use Control Implementation Plan (LUCIP) that is currently under revision.

Additionally, in accordance with the requirements of the *General Environmental Protection Plan, FUSRAP Maywood Superfund Site, Maywood, New Jersey*, November 24, 1999 (USACE 1999), an Environmental Monitoring Program (EMP) was established for the Site. One of the main objectives of the EMP is to ensure that the public and the environment are adequately protected from FUSRAP contaminants present at the Site. This is accomplished through annual monitoring of the air, surface water, sediment and groundwater. The results of the EMP are documented in an Annual Monitoring Report for each calendar year. The Annual Monitoring Reports used in preparing this Five-Year Review Report covered the calendar years 2009

through 2013. Prior to the establishment of the USACE EMP, DOE conducted a Site-wide environmental surveillance program to monitor conditions at the Site.

Progress Since Last Review

Excavation - More than 290,000 cubic yards of radiologically-contaminated soil was removed from the Site and disposed at off-site facilities that are permitted to accept the waste since the 2009 Five-Year Review was completed.

Comprehensive Property Evaluations - EPA, NJDEP and USACE conducted a review of investigation data that was compiled by USACE in a 2013 Technical Memorandum (Tech Memo). The results are discussed below.

Streets and Right-of-Ways Investigations – During July and August 2014, investigations were conducted in areas where radiological contamination was suspected to be located in streets and public right-of-way parcels, adjacent to areas that were remediated pursuant to the OU2 ROD or removal actions. Investigation results are expected in February of 2015 and will be used to delineate institutional controls.

Institutional Controls - Institutional controls in the form of deed notices, pursuant to NJDEP regulations, are actively being pursued by the USACE for properties where unrestricted cleanup criteria have not been met or inaccessible contamination remains on the property

Monitoring - Annual monitoring is carried out to ensure the local community is protected.

Protectiveness Statement from 2009 Five-Year Review

The previous five-year review for the Site indicated that the remedy implemented at the OU2 properties where the cleanup achieved the unrestricted use criteria is considered protective of human health and the environment. The remedy being implemented at the OU2 properties is considered protective of human health and the environment in the short-term. The OU2 remedy is expected to be protective of human health and the environment once fully implemented; however, long-term protectiveness of the remedy will require institutional controls for any property where radioactivity remains above the 2003 OU2 ROD unrestricted use cleanup criteria for soil or where the remediation of inaccessible soil is deferred until it is rendered accessible in the future. In the interim, protectiveness is being achieved through access controls, property owner notifications, monitoring, existing zoning ordinances and communication with local officials.

Recommendations identified in 2009 Five-Year Review

Recommendations and follow-up actions for individual properties where issues were identified in 2009 five-year review are listed below, including a progress update. The lists do not include those OU2 properties where remediation has been completed but no post- remediation data have been presented, or where remediation is still ongoing or yet to be implemented.

Phase I Properties Remediated During 1984-1985

For the three properties that have been identified with open issues, the following steps are recommended.

- For the 468 Davison Street, Maywood property - perform radon testing; additional investigations are warranted to locate the source of elevated radon levels if the 2003 OU2 ROD criteria for radon concentrations are not met. Conduct data evaluation/ investigations of the area exhibiting high gamma exposure rate and downhole gamma counts, in accordance with MARSSIM guidance. Complete property remediation if needed.
    - Progress – USACE attempted to gain access to the property to perform radon and additional investigations if deemed necessary. Many attempts to obtain access were made by certified mail, phone calls and visits to the home, but the owners did not grant access. USACE has abandoned further access attempts for this property.
- For the 58 Trudy Drive, Lodi property - conduct data evaluation/investigations of the area exhibiting radionuclide activity above the 2003 OU2 ROD soil cleanup criteria, in accordance with MARSSIM guidance. If the "unrestricted use" criteria are not met, additional remedial action may be required at the property.
    - Progress – Additional investigations were conducted in November 2013 and USACE determined that the cleanup criteria had been met and notified the property owner of the findings by letter.
- For the 96 Parkway, Rochelle Park property - conduct additional data evaluation/investigations in accordance with MARSSIM guidance, and complete remedial action as necessary if the 2003 OU2 ROD unrestricted use criteria are not met.
    - Progress – USACE conducted gamma surveys at the property and is planning to conduct soil investigation work at the property.

Phase I Properties Remediated During 1995-1999

For the two originally designated properties and one added property (9 Hancock Street, Lodi), which have been identified with open issues, the following steps are recommended.

- For the 112 Avenue E, Lodi property - conduct investigations for areas exhibiting radionuclide activity above the 2003 OU2 ROD soil cleanup criteria, in accordance with MARSSIM guidance. If the "unrestricted use" criteria are not met, additional remedial action may be required at this property.
    - Progress – A gamma walkover survey was conducted at the property in November 2013 and USACE determined that no further remedial work was needed because the property meets the OU2 ROD unrestricted cleanup criteria.
- For the 9 Hancock Street, Lodi property - conduct investigations for the interior and exterior areas that are suspected to have contamination but were not remediated during the Phase I cleanup effort. Complete property remediation if contaminated soil above the 2003 OU2 ROD soil cleanup criteria is identified.
    - Progress – A gamma walkover survey and soil sampling was conducted at the property in November 2013. A property investigation report was transmitted to EPA in September 2014 and is under review to determine if the OU2 unrestricted cleanup criteria were met.
- Implement LUCIP at the Lodi Municipal Park, Lodi property.
    - Progress – A gamma walkover survey and soil sampling was conducted at the property in November 2013. Due to the presence of mature trees and 36–inch, high-pressure gas main in the vicinity of contamination exceeding the cleanup criteria, it was determined that institutional controls would be established for this residual contamination. USACE revised the LUCIP in 2011 and is actively pursuing deed notices pursuant to NJDEP Technical Requirements.

Properties in the 2003 Record of Decision

For the six properties that have been identified with open issues, the following steps are recommended.

- For the Interstate 80, Lodi (1) east right-of-way and (2) beneath road west right-of-way property - implement the LUCIP and coordinate with NJDOT for future work to be performed at the highway to remove the inaccessible soil.
    - Progress – USACE revised the LUCIP in 2011 and is actively pursuing deed notices pursuant to NJDEP Technical Requirements.

- For the other five properties - implement the LUCIP and continue performing O&M, including radon testing and inspections, at the properties; complete removal action of the inaccessible soil when rendered accessible in the future by the property owners.

    - Progress – USACE has revised the LUCIP and is actively pursuing deed notices pursuant to NJDEP Technical Requirements. Annual monitoring continues to be performed at properties where inaccessible contamination is present.

- The 2009 Five-Year Review recommended that properties which were not addressed in the 2003 OU2 ROD will be included in a future CERCLA decision document. The five-year review further states that additional property evaluations for six Phase I properties will be performed as part of the future decision document, and the USACE will undertake these recommendations, as lead federal agency, with EPA oversight prior to the next five-year review.

    - Progress – EPA determined that a CERCLA decision document is not needed for additional property evaluations which are being conducted in accordance with the OU2 ROD cleanup criteria. Additional property evaluations were conducted by USACE with EPA and NJDEP approval, as documented in the 2013 Tech Memo. 20 properties were identified where additional information was needed to determine if the OU2 cleanup criteria were met. The necessary information for 19 of the 20 properties was obtained in 2013 and 2014. Four properties will require additional excavation work to meet the OU2 cleanup criteria and designs for this work is underway. Three properties will require land use controls or additional remedial action to meet the OU2 cleanup criteria.

Five-Year Review Process

Administrative Components

The five-year review team included Betsy Donovan (EPA-RPM), Michael Sivak (EPA-Human Health Risk Assessor), Mindy Pensak (EPA- Ecological Risk Assessor) and Wanda Ayala (EPA-Community Involvement Coordinator). This is a federal-lead Site. This is the second five-year review for the Maywood Site. The review components included: Community Involvement; Document Review; Data Review; Site Inspection; and Five-Year Review Report Development and Review.

Community Involvement

EPA distributed notices announcing that the five-year process was underway for the Maywood Chemical Site. Notices about the five-year review were placed on the EPA Region 2 Maywood Chemical Co. website at http://epa.gov/region02/superfund/npl/maywood/ and the USACE project website at http://fusrapmaywood.com/whatsnew.html. In addition, the notice announcing the five-year review was provided to the town officials and the library for public display. The

notice included contact information for EPA's Remedial Project Manager and Community Involvement Coordinator. The notice stated that the review would be completed by October 2014 and that the report would be available at the information repositories for the Site located in Maywood, New Jersey, and at the EPA Region 2 Records Center in New York City.

As the lead federal agency, DOE and its successor, USACE, established and maintained an extensive community involvement program. EPA has coordinated with the lead federal agencies throughout the project to ensure that the local community is kept well informed of cleanup activities. Communications with the property owners, surrounding community and local government officials is an ongoing and critical component of the remedial work. A Public Information Center with project records was established in the business district of Maywood, New Jersey. Project updates are prepared and sent out to the local community on a routine basis. USACE maintains a project website at http://www.fusrapmaywood.com/index.asp; the website includes project documents, maps, notices and updates. The nature of the work requires constant communication with property owners where cleanup is required from initial investigations until final property status reporting.

Document Review

The relevant documents, data and information which were reviewed in completing this five-year review include the 2003 OU2 ROD, EE/CA, RI/FS, PRARs, Radiological Characterization Reports, Independent Radiological Verification Reports, Annual Monitoring Reports, USACE 2013 Technical Memorandum (Tech Memo), and FUSRAP newsletters.

Data Review

Data were collected as part of the PRAR for each remedial action. In addition, data from the radiological characterization reports, 2013 Tech Memo and other Site investigation reports, and the Annual Monitoring Reports were reviewed to prepare this report.

EPA, NJDEP and USACE conducted a review of investigation data that was compiled by USACE in a 2013 Tech Memo. The 2013 Tech Memo documents the status of evaluations at the 88 "designated" properties where DOE determined radiological cleanup work was needed and 271 "undesignated" where DOE determined that no cleanup work was needed during the initial Site investigation work. These 271 properties were re-evaluated to ensure that conclusions reached during the initial investigation work are still valid. Based on the evaluation of Tech Memo data and the 2009 Five-Year Review findings, additional investigation work was recommended at 20. Additional investigations were performed at 19 of the 20 properties where access was obtained. Results of these investigations found four properties where cleanup work is needed to meet the OU2 ROD cleanup criteria and three properties where land use controls or further remedial actions are needed.

An annual Environmental Monitoring Program has been implemented for the Site to ensure that the public and the environment are adequately protected from FUSRAP contaminants, through annual monitoring of the air, surface, sediment, and groundwater at the Site. Based on the 2013 Annual Monitoring Report, the monitoring results were within the historical ranges and comparable to those reported in previous years.

The measured concentrations of radionuclides of concern in sediment samples collected in Westerly and Lodi brooks did not exceed the soil cleanup criteria established in the OU2 ROD during the five year review period. Sediment and surface water concentrations measured during the annual environmental sampling events are significantly below the referenced radiological benchmarks protective of aquatic habitats. The surface water and sediment concentrations for contaminants of concern along Lodi Brook are trending downward over time, which can be attributed to the previous and ongoing remedial actions along Lodi Brook.

Site Inspection and Interviews

The inspection of the Site was conducted on August 11, 2014. In attendance were Betsy Donovan, EPA; Mindy Pensak, EPA; James Moore, USACE; John Canby, USACE; and Matthew Creamer, USACE. The USACE Maywood FUSRAP project team members discussed remedial action progress since the last five-year review was completed and provided several drawings that noted excavation areas completed. A tour of the MISS soil stockpile, railroad load-out system used for transportation of waste for off-site disposal, active construction area on MISS and on-site laboratory took place. The team did not conduct interviews during the site inspection because Site communication activities for the ongoing and future cleanup work were deemed sufficient. EPA held a public meeting in 2013 to inform the public of the proposed cleanup work for the OU1 chemical contamination. USACE maintains a robust communications program for the ongoing soil cleanup work which includes a website, a public information center located in Maywood, newsletters and outreach to the local community.

Institutional Controls Verification

USACE, as lead federal agency, will implement the recommended land use controls and monitoring to ensure long-term protectiveness, with EPA oversight prior to the next five-year review.

Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

Answer A: Yes, the remedy is functioning as intended by the 2003 OU2 ROD in the short-term. However, for the remedy to function as intended in the long-term, institutional controls need to be in effect for properties where radioactivity remains

above 5 pCi/g of Ra-226 and Th-232 combined above background concentrations for soil.

Summary of Data Review – PRARs, 2013 Tech Memo and Annual Monitoring Reports were the main sources of data reviewed for this report.

Remedial Action Performance and Monitoring Results - The remedial action consisting of excavation and off-site disposal of soils exceeding the 2003 OU2 ROD cleanup criteria is progressing and continues to be implemented as designed. The remedial action is performing as expected, with RAOs being achieved in a reasonable timeframe.

System Operations/O&M - The past and current operations maintain the effectiveness of the remedial actions undertaken at the OU2 properties.

Opportunities for Optimization - Opportunities for optimization were not identified in this five-year review.

Early Indicators of Potential Remedy Problems - Early indicators of potential remedy problems were not identified in this five-year review.

Implementation of Institutional Controls and Other Measures - Per the 2003 OU2 ROD, institutional controls are required for properties with inaccessible soils or properties exhibiting residual radioactivity in soil above an unrestricted use cleanup criteria (i.e., an average of 5 pCi/g of Ra-226 and Th-232 combined above background). No long-term, project specific institutional controls have been implemented at the Site to date. USACE has drafted a LUCIP which is currently under revision; in the interim, USACE is negotiating land use controls with some property owners.

Exposures at the MISS, Stepan and OU2 properties with ongoing remedial action, which could potentially result in unacceptable risks, are being controlled through access controls, fencing, security guard, warning signs, work place management practices, property owner notifications, monitoring, existing zoning ordinances and communication with local officials and affected property owners. In addition, properties with inaccessible contamination are routinely monitored for gamma exposure rates and radon in buildings. In all cases, the measurements have not required further actions and meet applicable gamma dose and radon levels.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

Yes. The current cleanup levels and RAOs, as specified in the 2003 OU2 ROD remain valid and are the basis for the protectiveness determination in this five-year review. In addition, the post-remediation data for all actions undertaken prior to the OU2 remedy the Site have been compared to OU2 cleanup levels.

Changes in Risk Assessment Methods – Standardized risk assessment methodologies have not changed and therefore do not affect the current protectiveness of the remedy.

Changes in Exposure Pathways – Existing and anticipated land use on and near the site have not changed. Human health and ecological routes of exposure or receptors have not changed in a way that could affect the protectiveness of the remedy. There are no newly identified contaminants or contaminant sources. Radioactive decay products are being addressed by the remedy. Physical Site conditions have not changed in ways that could affect the protectiveness of the remedy.

Changes in Standards and TBCs- Standards identified in the ROD have not been revised or called into question the protectiveness of the remedy. There are no newly promulgated standards that call into question the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics – Toxicity factors and contaminant characteristics have not changed in a way that could affect the protectiveness of the remedy. In June 2014, the Office of Superfund Remediation and Technology Innovation (OSRTI) released the "Radiation Risk Assessment at CERCLA Sites: Q&A," which suggested that a cleanup level of 12 mrem/year be used instead of the previously recommended value of 15 mrem/year. This value is being evaluated in the context of the OU2 remedy and will be discussed further in the next five-year review.

The 1993 Risk Assessment concluded that remedial action would likely remove contaminated soils to depths affecting ecological resources. The habitat at the Maywood Site and surrounding and downstream properties is typical of urban areas, and generally consists of early to late old-field stages, usually along transportation rights-of-way or unused corners of commercial/industrial properties. Overall there is very little wildlife habitat in the vicinity of the Site, other than ornamental plantings, mowed lawns and scattered patches of wooded and herbaceous vegetation along stream corridors and dividing lines of commercial/industrial properties. Some wetland vegetation is present along the brooks and some drainage swales within the boundaries of the FUSRAP Maywood Site. Westerly and Lodi Brooks are underground for most of their length; near the Saddle River, riparian vegetation is found along the banks of both brooks.

Although the ecological risk assessment screening and toxicity values used to support the OU2 ROD may not necessarily reflect the current values, the remedial action objectives for source media (soil and bulk waste) remain protective of the environment and the selected remedy consisting of the excavation of contaminated soils and burial pits along with the excavation of contaminated sediments from wetland habitats and off-site disposal of contaminated material eliminates any potential risk from surface soil contaminants to terrestrial receptors.

The OU2 RAOs remain valid and protective.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no new information to call into question the protectiveness of the remedy.

Issues, Recommendations and Follow-up Actions

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU2	**Issue Category: Institutional Controls**			
	Issue: The selected remedy for OU2 soil and buildings has not been fully implemented. Additional remedial actions and institutional controls, which are part of the OU2 remedy, are needed.			
	Recommendation: Implement the Land Use Control Implementation Plan to fulfill the institutional control requirements for any property where radioactivity remains above the 2003 OU2 ROD unrestricted use cleanup criteria for soil and where inaccessible radioactive soil contamination remains in place.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	9/25/2017
OU(s): OU2	**Issue Category: Monitoring**			
	Issue: New EPA Radiation Exposure Guidance was issued in June 2014.			
	Recommendation: Evaluate new guidance and determine if it affects the OU2 remedy.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	**No**	**Federal Facility**	**EPA/State**	**9/25/2015**

Protectiveness Statement

Protectiveness Statement	
Operable Unit:	*Protectiveness Determination:*
OU2	Will be Protective
Protectiveness Statement:	
The remedy currently being implemented at OU2 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.	

Next Review

The next five-year review report for the Maywood Chemical Company Superfund Site is required five years from the completion date of this review.

Tables

Table 1: Chronology of Site Events

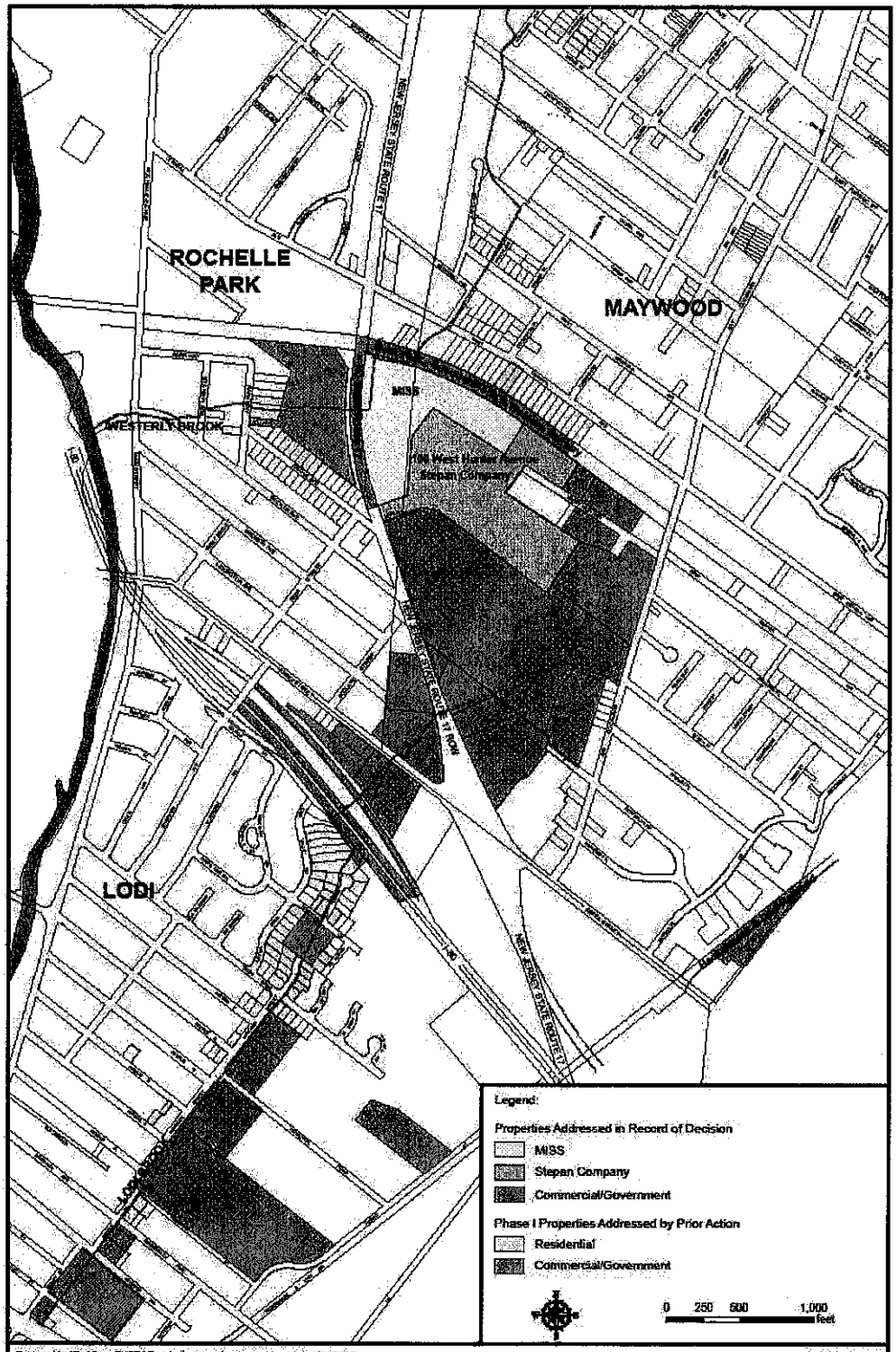
Event	Date(s)
Maywood Chemical Works (MCW) receives Atomic Energy Commission (AEC) License R-103 for thorium possession, processing and re-sale.	1954
Processing of monazite sands for rare earths and thorium ceases.	1956
AEC License R-103 expires.	1957
Stepan Chemical Company buys MCW and applies for AEC license "to cover our operations as processors and exporters of source material." Application states "active manufacturing in the Thorium Plant is at a standstill."	1959
Stepan receives an AEC radioactive materials license.	1961
Based on AEC inspections and information related to a property west of NJ State Route 17, known as the Ballod property, Stepan agreed to take certain corrective actions and began to clean up residual thorium waste, by partially stabilizing residues and tailings.	1963
Stepan removed approximately 19,100 cubic yards (cy) of contaminated soil from the Ballod property and placed it into three burial pits (1, 2 & 3) on the Stepan property.	1966-1968
EPA added the site to the Superfund National Priorities List. In late 1983, Congress assigned DOE a research and development project to clean up the radioactive wastes at the site (via the FY84 Energy and Water Appropriations Act).	1983
DOE assigned the site to the Formerly Utilized Sites Remedial Action Program (FUSRAP). The site consists of a total of 88 designated industrial, residential, commercial and government properties.	1983
DOE began investigating the site and surrounding area. Vicinity properties on Grove Avenue and Parkway in Rochelle Park were surveyed in late 1983, and nine of the surveyed properties were designated for remedial action as a result. In addition, a "drive-by" gamma survey followed by ground surveys that included limited sampling was completed for properties in Lodi.	1983-1984

Approximately 35,000 cy of contaminated materials were removed from the Ballod property and from 17 vicinity properties on Davison Avenue, Latham Street, Grove Avenue, and Parkway in Maywood and Rochelle Park. An additional 500 cy of contaminated materials were removed from eight vicinity properties located on Avenue C, Avenue F, Hancock Street, and Trudy Drive in Lodi, and another portion of the Ballod property in Rochelle Park. The excavated materials were stored in a protective enclosure cell on a portion of 100 West Hunter Avenue (now known as the Maywood Interim Storage Site (MISS)) which DOE acquired in 1985 to expedite cleanup of the vicinity properties.	1984-1985
Federal Facility Agreement (FFA) signed by EPA and DOE	1990
A time-critical removal action was undertaken by DOE to decontaminate one additional residential property in Lodi due to the significantly elevated gamma exposure rates measured inside the residence.	1991
DOE issued *Remedial Investigation Report for the Maywood Site.*	1992
DOE *Final Baseline Risk Assessment for the Maywood Site*	1993
Additional cleanup criteria for the radionuclide contamination in soil at the site were established in 1994. DOE implemented interim property cleanups as removal actions as described in the September 1995 *Engineering Evaluation/Cost Analysis (EE/CA) for the Cleanup of Residential and Municipal Vicinity Properties at the Maywood Site, Bergen County, New Jersey* under CERCLA.	1994-1995
Cleanup at fourteen residential properties, four municipal properties (three parks and a fire station) and one commercially zoned property was initiated. Previously stored excavated materials were removed from the MISS and sent to a permanent, off-site commercial disposal facility.	1995-1997
USACE performed remediation of the remaining 23 vicinity properties. During these cleanup actions, an additional five properties in Lodi and Maywood were remediated as the contamination extended onto adjacent undesignated properties.	1997-1999

A time critical removal action was completed by USACE during the winter of 2000 to remove contaminated sediments from portions of Lodi Brook and a swale located at the terminus of West Howcroft Road. The removal action re-established the hydraulic grade of the brook and swale, prevented additional flooding, and prevented the transport or migration of contaminated soil by flooding water.	2000
USACE issued *Engineering Evaluation/Cost Analysis for a Removal Action in Support of NJDOT Roadway Improvement Projects at the FUSRAP Maywood Superfund Site (FMSS).*	2001
The *Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site* was completed and submitted for public comment along with the *Proposed Plan for Soils and Buildings at the FUSRAP Maywood Superfund Site.*	2002
EPA and USACE signed the *Record of Decision (ROD) for Soils and Buildings at the Maywood Superfund Site.*	2003
Remedial design for FUSRAP Soils and Buildings start	2003
Remedial design for FUSRAP Soils and Buildings complete	2004
On-site FUSRAP Soils and Buildings remedial action construction start	2004
Post Remedial Action Reports for individual properties	2005 to present
First five-year review report	2009
USACE Technical Memo assessing all property investigations and cleanups to date	2013

Table 2: Cleanup Critera from the OU2 ROD		
Contaminant of Concern		**Cleanup Criteria**
Radionuclides in Soil	Ra-226 Th-232	Unrestricted use properties: an average of 5 pCi/g[1] Ra-226 and Th-232 combined above background Restricted use properties: an average of 15 pCi/g Ra-226 and Th-232 combined above background for subsurface soils with an ALARA goal of 5 pCi/g
	U-238	100 pCi/g total uranium, 50 pCi/g U-238
Exposure Dose Limit		15 mrem/yr[2] above background dose limit specified in NJAC 7:28-12.8(a)1
Radon and Radon Decay Products in Structure		Indoor radon air concentration: 3 pCi/L[3] radon-222 (Rn-222) limit specified in the NJAC 7:28-12.8(a)2

1 - picoCuries per gram 2 - millirem per year 3 – picoCuries per liter


ROCHELLE PARK
MAYWOOD
LODI
WESTERLY BROOK
NEW JERSEY STATE ROUTE 17
NEW JERSEY STATE ROUTE 17
NEW JERSEY STATE ROUTE 17
MSS
Legend:
Properties Addressed in Record of Decision
MSS
Stepan Company
Commercial/Government
Phase I Properties Addressed by Prior Action
Residential
Commercial/Government
0 250 500 1,000
feet
Source: Modified from FUSRAP website (www.fusrapmaywood.com, 3/4/2009)
CDM
Figure 1-1
Site Map
Maywood Chemical Co. Superfund Site
Bergen County, New Jersey

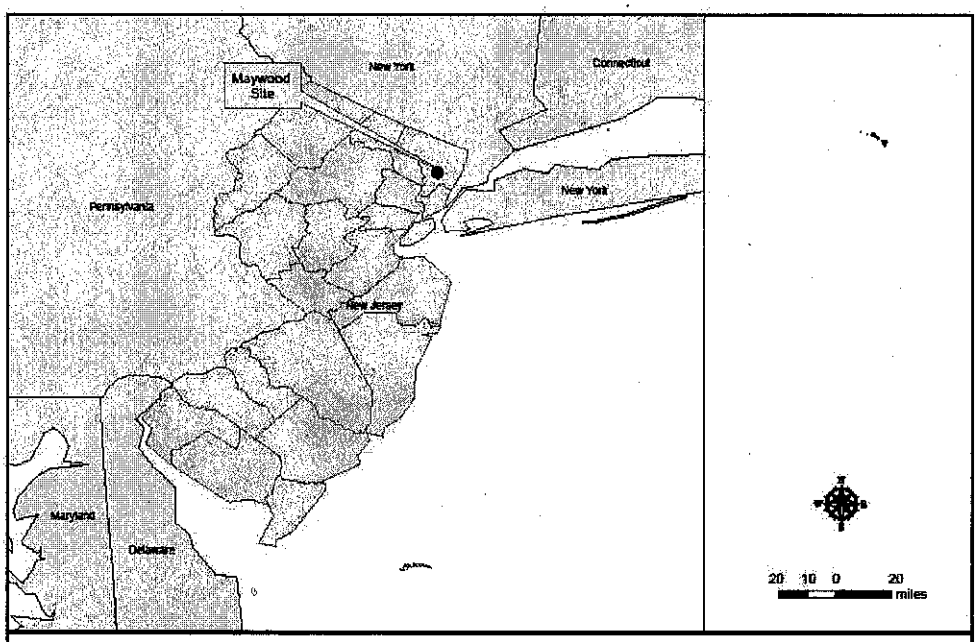


Figure 3-1
Site Location Map
Maywood Chemical Co. Superfund Site
Bergen County, New Jersey

CDM